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Sitting too much: A hierarchy of socio-demographic correlates☆

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ABSTRACT

Too much sitting (extended sedentary time) is recognized as a public health concern in Europe and beyond. Time spent sedentary is influenced and conditioned by clusters of individual-level and contextual (upstream) factors. Identifying population subgroups that sit too much could help to develop targeted interventions to reduce sedentary time. We explored the relative importance of socio-demographic correlates of sedentary time in adults across Europe.

We used data from 26,617 adults who participated in the 2013 Special Eurobarometer 412 “Sport and physical activity”. Participants from all 28 EU Member States were randomly selected and interviewed face-to-face. Self-reported sedentary time was dichotomized into sitting less or >7.5 h/day. A Chi-squared Automatic Interaction Detection (CHAID) algorithm was used to create a tree that hierarchically partitions the data on the basis of the independent variables (i.e., socio-demographic factors) into homogeneous (sub)groups with regard to sedentary time. This allows for the tentative identification of population segments at risk for unhealthy sedentary behaviour. Overall, 18.5% of the respondents reported sitting >7.5 h/day. Occupation was the primary discriminator. The subgroup most likely to engage in extensive sitting were higher educated, had white-collar jobs, reported no difficulties with paying bills, and used the internet frequently. Clear socio-demographic profiles were identified for adults across Europe who engage in extended sedentary time. Furthermore, physically active participants were consistently less likely to engage in longer daily sitting times. In general, those with more indicators of higher wealth were more likely to spend more time sitting.

“We seem busier than ever, but in a sedentary way”

[*Sally Norton*]

1. Introduction

Sedentary behaviours – defined as behaviours that involve sitting or reclining positions and low levels of energy expenditure (≤1.5 metabolic equivalents) during waking hours (Sedentary Behavior Network, 2012) – have emerged as a public health concern in Europe (Owen et al., 2010; Owen et al., 2011). Sedentary behaviours have been associated with a range of detrimental health outcomes such as depression, obesity, type 2 diabetes, cardiovascular disease, and all-cause mortality (Biswas et al., 2015; Chau et al., 2012). These outcomes are often independent of physical activity levels (Owen et al., 2010; Chau et al., 2013; Bennie et al., 2013; Sjöström et al., 2006). Especially in western society, substantial time is spent sedentary (Owen et al., 2010). Investigating the prevalence and correlates of sedentary behaviours is important to monitor and understand population levels as well as to identify at-risk populations to be targeted by interventions.

So far, studies on correlates of sedentary behaviour in adults have mainly focused on association of single socio-demographic correlates (risk-factors) rather than clusters of socio-demographic variables (risk-profiles) with sedentary time. For example, previous studies were consistent in finding that higher-educated people were more likely to sit too much (e.g. (Bennie et al., 2013; Sjöström et al., 2006;

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Bauman et al., 2011). Whereas most of these studies used multivariable models taking other variables into account, they did not explore who of those highly educated people sit more or less. The interrelations across factors need to be taken into account in order to untangle *who* is sitting too much in *what* contexts, and *how* these factors cluster.

In Europe, recent studies have estimated the prevalence and correlates of sedentary time using the Eurobarometer surveys. These surveys are conducted biannually across the European Union and occasionally include questions about sedentary behaviour. To date, these Eurobarometer surveys are the most comprehensive source of data on population levels of sedentary time across all countries in Europe (Loyen et al., 2016a). Previous studies have used the Eurobarometer to study socio-demographic correlates associated with sedentary time, suggesting that males, younger and highly educated people engage in high levels of sedentary behaviour (i.e., >7.5 h/day) (Bennie et al., 2013; Sjöström et al., 2006; Loyen et al., 2016b). Bauman et al. showed similar results for a worldwide sample for young and highly educated adults, (Bauman et al., 2011) but they found no difference according to gender with regard to sedentary time. In a systematic literature review, Rhodes et al. also suggested that gender was not significantly associated with sedentary time (Rhodes et al., 2012) Furthermore, living in rural areas or small/medium-sized towns - as compared to more urbanized areas - was identified to be inversely correlated with sedentary time in the Eurobarometer studies (Sjöström et al., 2006; Loyen et al., 2016b). The Eurobarometer survey wave from 2013 included additional socio-demographic factors that we recently used to describe the prevalence and correlates of self-reported sitting time in the 28 European Union member states (Loyen et al., 2016b). The findings suggested that in addition to the factors mentioned above, white-collar employment may be important for extended sedentary time, as well as being widowed and having a low life satisfaction (Loyen et al., 2016b).

Our aim is to move beyond the evaluation of distinct individual-level correlates. Rather, we use a data driven approach to assess the concurrence between and clustering of potential risk factors for extended sedentary time, i.e., we seek to identify risk profiles.

2. Methods

This study was undertaken as part of the DEterminants of DIet and Physical Activity (DEDIPAC) Knowledge Hub, a joint action as part of the European Joint Programming Initiative 'a Healthy Diet for a Healthy Life' (Lakerveld et al., 2014). For the current study, data from the cross-sectional Special Eurobarometer 412 "Sport and physical activity" were used (European Commission, 2014). The Eurobarometer surveys are conducted biannually in the 28 European Union Member States on behalf of the European Commission. In November and December 2013, the survey was carried out by TNS Opinion & Social among approximately 1000 participants per country. A multistage random sampling design was used to sample participants per country, based on population size and density. Each initial address was selected at random; further addresses were selected by randomly selected route. In each household, the respondent with the closest birthday to the date of the interview was selected. In total 27,919 participants were interviewed face-to-face in their mother tongue.

2.1. Sitting time

Sitting time was assessed with the question: "How much time do you spend sitting on a usual day?" which is part of the validated short International Physical Activity Questionnaire (IPAQ) (Rosenberg et al., 2008). The IPAQ sitting question was adapted as they opted to have answering categories instead of an open ended question. There were eleven response categories: 1 h or less, 1 h to 1.5 h, 1.5 h to 2.5 h, 2.5 h to 3.5 h, 3.5 h to 4.5 h, 5.5 h to 6.5 h, 6.5 h to 7.5 h, 7.5 h to 8.5 h, >8.5 h, and 'don't know'. The response categories were dichotomized into sitting ≤7.5 h/day and sitting >7.5 h/day to study low versus extended sedentary time. This cut-off was chosen based on a meta-analysis of Chau et al. (2013) in which it was suggested that the risk of all-cause mortality increases when adults self-reported to sit more than approximately 7–8 h/day.

2.2. Socio-demographic variables

The following socio-demographic variables were assessed: 1) gender, 2) age, 3) country of residence, 4) marital status, 5) level of education, 6) current occupation, 7) type of community, 8) number of children in the household, 9) car ownership, 10) computer ownership, 11) internet use frequency, 12) difficulties paying bills, and 13) life satisfaction. All data were self-reported except for country of residence, which was reported by the interviewer. For trend analyses purposes, Eurobarometer still distinguishes West- and East Germany, and we combined these into Germany. Furthermore, we combined England and Northern Ireland into the United Kingdom. Marital status was recoded into five categories: (re-)married, single living with a partner, single, divorced or separated, and widowed. The level of education was measured by the question "How old were you when you stopped full-time education?" and was recoded into four possible categories: up to 15 years, 16–19 years, >20 years, and still studying. Current occupation was recoded into seven categories: self-employed (farmer/fisherman, professional, owner of a shop, craftsmen, business proprietors), managers (employed professional, general management, middle management), white-collar (employed position at desk, employed position travelling), manual worker (employed position service job, supervisor, skilled manual worker, unskilled manual worker), house persons, unemployed, retired, and students. Three 'types of community' were distinguished: rural area or village, small or medium sized town, large town. The number of children aged <10 years and aged 10 to 14 years were combined in the variable 'Children aged <15 years living in the household' and coded into four categories: none, one, two, three or more. Internet use frequency was measured in six categories: everyday/almost every day, two or three times in a week, about once a week, two or three times a month, less often, never/no access. Difficulties paying bills was measured in three categories: almost never/never, from time to time, most of the time. Life satisfaction was measured by the question "On the whole, are you satisfied with the life you lead" and included four response categories: very satisfied, fairly satisfied, not very satisfied, or not at all satisfied.

2.3. Physical activity

Total physical activity was assessed using the IPAQ-short. This questionnaire asks about the number of days and the average time respondents participated in moderate and in vigorous physical activity, and walking in the last seven days. Response options were: 30 min or less, 31 to 60 min, 61 to 90 min, 91 to 120 min, >120 min, 'never', and 'don't know'. We calculated MET-minutes/week using the following formula: (days of vigorous PA ∗ time in vigorous PA ∗ 8.0) + (days of moderate PA ∗ time in moderate PA ∗ 4.0) + (days walking ∗ time walking ∗ 3.3) (Loyen et al., 2016a; The IPAQ group, 2017). In this process, we took the midpoint of each category to represent the time (e.g. the '31 to 60 min' category was transformed into '45 min') and capped the '>120 min' category at 135 min.

2.4. Statistical analyses

Participants were excluded from the analyses when they were aged younger than 18 years old and/or when they answered 'don't know' on the sitting question. Descriptive statistics were used to describe the characteristics of the total sample and the groups sitting less and >7.5 h/day. To identify the relative importance of correlates associated with sitting too much, we employed the CHi-squared Automatic Interaction Detection (CHAID) algorithm (Kass, 1980). CHAID creates a dendrogram (or tree) that hierarchically partitions the data on the basis of the independent variables (i.e., socio-demographic factors) into homogeneous (sub)groups. This allows for the tentative identification of population segments that have a higher likelihood to sit >7.5 h/day, and the resulting tree supports straightforward interpretation of complex interactions.

The CHAID algorithm first evaluates, for each predictor (i.e. the socio-demographic variables described above), which response categories may be merged without losing information in order to find a parsimonious partition of each predictor. Then, using Bonferroni Type-I error control, the most discriminative predictor is chosen and the data are subdivided according to its categories. For each resulting subdivision of the data (node) the process of finding the most discriminative socio-demographic predictor is then repeated. In this way the data branches out into a tree in which the nodes indicate (partitions according to) predictor categories. See Supplementary File 1 for additional information on the CHAID algorithm and our use of it in producing a tree.

In the visualization of the final tree the percentage of people sitting >7.5 h/day is presented for each node, as well as the response index (RI). The RI is the percentage of each subgroup that sit too much, relative to the percentage that sit too much of the total sample (i.e., 18.5%). As such, the RI presents the direction and strength of the association similar to an odds ratio.

As a sensitivity analysis, we repeated the analyses as above, including total physical activity. This was done to test if the risk stratification of too much sitting was changed by the inclusion of physical activity, and to see which of the at risk groups of extended sitting also engaged in lower physical activity levels. These additional steps were not considered as primary analyses due to our aim to identify socio-demographic profiles of those who sit too much.

3. Results

3.1. Participants

Of the 27,919 participants, 610 participants (2.2%) were excluded because they were aged under 18 and 692 participants (2.5%) because they did not answer the question about sitting time. As a result, the final sample consisted of 26,617 participants. The mean age of this sample was 50.1 years (SD 17.5), and 54.7% was female. Overall, 18.5% reported to sit >7.5 h/day. Demographic characteristics for the full sample and the high/low sitting groups are presented in Table 1. These descriptive results are identical to those reported in our previous paper on risk correlates (Loyen et al., 2016b).

3.2. Hierarchy of correlates of sitting >7.5 h/day

The final CHAID tree is shown in Fig. 1, and consists of five layers (depths), 76 groups, and 45 terminal groups. The variable that was hierarchically most important to discriminate sitting >7.5 h/day was type of occupation. With an RI of 1.9, those with white-collar jobs were most at risk to sit >7.5 h/day, whereas house persons had the lowest likelihood (RI 0.36) (Fig. 1). The subgroup with the highest sitting rates were participants with white-collar jobs that had no difficulties paying bills, reported to frequently use the internet, and were highly educated. In total, 47.5% of the respondents in this subgroup reported sitting >7.5 h/day. Least likely to sit >7.5 h/day were (re)-married females who were retired or self-employed, who lived in Spain, Ireland, Italy, Portugal, Malta, or Slovenia, and who were fairly satisfied or less (2.9%, RI = 0.16).

Country of residence was only a predicting factor for managers and students, and retired or self-employed participants. The variables ‘gender’ and ‘type of community’ most frequently appeared in the model, whereas the other variables only appeared once or twice. Participants living in urban areas consistently showed higher likelihoods of sitting too much as compared to those living in smaller towns or rural areas. Females were more at risk of sitting too much, but only in specific contexts: when they had a white-collar job or being a manual worker, whereas retired and self-employed men reported more sitting than women.

The CHAID tree in which physical activity was added is shown in Supplementary File 2. Also here, type of occupation showed to be the most prominent discriminator. Activity appeared frequently and relatively high in the tree – at least for some sub-groups. Where it appeared (e.g., in those who were retired/self-employed, and manual workers) it consistently showed that those with lower activity levels were more likely to engage in longer daily sitting times, and these subgroups were mostly too small to further dissect. Three main high-sitting low-active subgroups could be identified: 1) White collar workers from Finland, Austria, Germany, the United Kingdom, and Eastern-European countries (RI 2.32); 2) Retired or self-employed respondents from Denmark and the Netherlands (RI 2.21); and 3) Students and managers from Greece, Finland, France, Germany, the United Kingdom, Malta, Poland, Romania and Slovakia (RI 2.01).

4. Discussion

In this study we examined the hierarchy of socio-demographic correlates of engaging in extended sedentary time. CHAID analysis was used to build a decision tree to identify profiles of adults most at risk of sitting >7.5 h/day. The tree showed that current occupation was the primary discriminator. Highly educated adults with white-collar jobs, no difficulties paying bills and frequent internet use were most likely to sit too much, while retired or self-employed women living in Spain, Ireland, Italy, Portugal, Malta and Slovenia, who were (re-) married and not very satisfied with their lives were least likely to engage in extended daily sitting.

Having a desk-bound job has also been recognized as key characteristic in other populations (Jans et al., 2007; Mummery et al., 2005). It has been shown that there are major differences across types of occupations with regard to average sitting times, and the - often desk-based - white-collar jobs were accountable for the majority of sedentary behaviour on workdays (Jans et al., 2007; Saidj et al., 2015). It may be a logical consequence that high amounts of sitting times are reached when an average workday in a ‘sedentary occupation’ generally consists of about 8 h.

Higher socioeconomic status was related to extended sedentary time. Interestingly, also within the white-collar job subgroup, people with a higher socioeconomic status (as indicated by proxies such as higher educational attainment and having no problems paying bills) were more sedentary than people with a lower socioeconomic status. The link between having a white-collar occupation and sitting too much was consistent across countries, whereas for other occupational groups the relation was country-specific.

Gender was frequently picked up as a correlate of sedentary time. However, there did not seem to be a clear pattern as to when women sat more or less. This could explain the inconsistency found in previous studies with regard to gender differences in extended sedentary behaviours (e.g. (Bennie et al., 2013; Bauman et al., 2011; Rhodes et al., 2012). These inconsistencies may have been due to the specific socio-demographic correlates under study.

Participants living in large towns consistently belonged to the subgroup with the highest percent of sedentary time. This is in line with the findings from the 2002 and the 2013 Eurobarometer (Sjöström et al., 2006; Loyen et al., 2016b). Type of community was a recurrent variable in the model, flagging its potential importance for predicting sedentary time. The merits of CHAID as compared to the analytical approaches used in the previous Eurobarometer studies on sedentary behaviour is that it does not force a fixed model but allows for different combinations of socio-demographic factors in order to identify different subgroups (i.e. branches in the decision tree). In addition, the results allow a visual representation of the hierarchy of factors, with the branches typifying distinct clusters of factors that form profiles of

Table 1
Demographic characteristics (mean (SD), median (IQR) or percentages) of the study sample, with the distribution of participants sitting ≤7.5 h/day or >7.5 h/day).

	N (% of total sample)	Sitting ≤ 7.5 h/day (within group %)	Sitting > 7.5 h/day (within group %)
Overall	26,617 (100)	21,696 (81.5)	4921 (18.5)
Age, years (mean ± SD)	50.1 ± 17.5	50.2 ± 17.3	49.8 ± 18.3
Gender			
Male	12,062 (45.3%)	9705 (80.5%)	2357 (19.5%)
Female	14,555 (54.7%)	11,988 (82.4%)	2567 (17.6%)
Country			
Netherlands	991 (3.7%)	673 (67.9%)	318 (32.1%)
Denmark	984 (3.7%)	672 (68.3%)	312 (31.7%)
Czech Republic	985 (3.7%)	724 (73.5%)	261 (26.5%)
Sweden	974 (3.7%)	738 (75.8%)	263 (24.2%)
Estonia	983 (3.7%)	759 (77.2%)	224 (22.8%)
Croatia	978 (3.7%)	756 (77.2%)	222 (22.7%)
Finland	942 (3.5%)	741 (78.7%)	201 (21.3%)
Luxembourg	484 (1.8%)	384 (79.3%)	100 (20.7%)
Greece	973 (3.7%)	779 (80.1%)	194 (19.9%)
Slovakia	956 (3.6%)	766 (80.1%)	134 (19.9%)
Bulgaria	947 (3.6%)	760 (80.3%)	187 (19.7%)
United Kingdom	1267 (4.8%)	1023 (80.7%)	244 (19.3%)
Republic of Cyprus	482 (1.8%)	390 (80.9%)	92 (19.1%)
Austria	948 (3.6%)	768 (81.0%)	180 (19.0%)
Germany	1531 (5.8%)	1251 (81.7%)	280 (18.3%)
France	991 (3.7%)	810 (81.7%)	181 (18.3%)
Poland	879 (3.3%)	721 (82.0%)	158 (18.0%)
Belgium	1042 (3.9%)	856 (82.1%)	186 (17.9%)
Latvia	964 (3.6%)	796 (82.6%)	168 (17.4%)
Lithuania	963 (3.6%)	802 (83.3%)	161 (16.7%)
Romania	927 (3.5%)	794 (85.7%)	133 (14.3%)
Slovenia	1094 (4.1%)	960 (87.8%)	134 (12.2%)
Malta	488 (1.8%)	430 (88.1%)	58 (11.9%)
Hungary	974 (3.7%)	859 (88.2%)	115 (11.8%)
Italy	955 (3.6%)	850 (89.0%)	105 (11.0%)
Ireland	953 (3.6%)	854 (89.6%)	99 (10.4%)
Portugal	980 (3.7%)	882 (90.0%)	98 (10.0%)
Spain	982 (3.7%)	895 (91.9%)	87 (8.9%)
Marital status			
(Re-) married	14,084 (52.9%)	11,727 (83.3%)	2357 (16.7%)
Single living with partner	2977 (11.2%)	2376 (79.8%)	601 (20.2%)
Single	4420 (16.6%)	3493 (79.0%)	927 (21.0%)
Divorced or separated	2221 (8.3%)	1792 (80.7%)	429 (19.3%)
Widow	2535 (9.5%)	2015(79.5%)	520 (20.5%)
Level of education			
Up to 15 years education	4540 (17.0%)	3911 (86.1%)	629 (13.9%)
16–19 years education	11,794 (44.3%)	9964 (84.5%)	1830 (15.5%)
20 + years education	8500 (31.9%)	6494 (76.4%)	2006 (23.6%)
Still studying	1270 (4.8%)	914 (72.0%)	356 (28.0%)
Current occupation			
Self-employed	1971 (7.4%)	1625 (82.5%)	346 (17.5%)
Managers	2662 (10.0%)	1856 (69.7%)	806 (30.3%)
White-collar	3205 (12.0%)	2080 (64.9%)	1125 (35.1%)
Manual worker	5368 (20.2%)	4487 (91.0%)	481 (9.0%)
House persons	1929 (7.2%)	1800 (93.3%)	129 (6.7%)
Unemployed	2153 (8.1%)	1910 (88.7%)	243 (11.3%)
Retired	8059 (30.3%)	6621 (82.2%)	1438 (17.8%)
Student	1270 (4.8%)	914 (72.0%)	356 (28.0%)
Children aged < 15 years living in household			
None	19,969 (75.0%)	16,209 (81.2%)	3760 (18.8%)
One	3401 (12.8%)	2773 (81.5%)	628 (18.5%)
Two	2458 (9.2%)	2015 (82.0%)	443 (18.0%)
Three or more	789 (3.0%)	696 (88.2%)	93 (11.8%)
Computer ownership			
Yes	19,798 (74.5%)	15,953 (80.6%)	3845 (19.4%)
No	6819 (25.6)	5740 (84.5%)	1079 (15.8%)
Car ownership			
Yes	19,027 (71.5%)	15,548 (81.7%)	3479 (18.3%)
No	7595 (28.6)	6145 (81%)	1445 (19.0%)
Internet use			
Every day/almost every day	15,031 (56.5%)	11,669 (77.6%)	3362 (22.4%)
Two or three times in a week	2556 (9.6%)	2270 (88.8%)	286 (11.2%)
About once a week	804 (3.0%)	731 (90.9%)	73 (9.1%)

Table 1 (*continued*)

	N (% of total sample)	Sitting ≤ 7.5 h/day (within group %)	Sitting > 7.5 h/day (within group %)
Two or three times a month	308 (1.2%)	268 (87.0%)	40 (13.0%)
Less often	579 (2.2%)	521 (90.0%)	58 (10.0%)
Never/no access	7339 (27.6%)	6234 (84.9%)	1105 (15.1%)
Difficulties paying bills			
Almost never/never	15,455 (58.1%)	12,273 (79.4%)	3182 (20.6%)
From time to time	7334 (27.6%)	6228 (84.9%)	1106 (15.1%)
Most of the time	3394 (12.8%)	2850 (84.0%)	544 (16.0%)
Life satisfaction			
Very satisfied	6282 (23.6%)	5016 (79.4%)	1266 (20.6%)
Fairly satisfied	14,375 (54%)	11,754 (84.9%)	2621 (15.1%)
Not very satisfied	4518 (17.0%)	3776 (93.6%)	742 (16.4%)
Not at all satisfied	1299 (4.9%)	1036 (79.7%)	263 (20.3%)
Type of community			
Rural area or village	9124 (34.3%)	7766 (85.1%)	1357 (14.9%)
Small or medium sized town	9983 (37.5%)	8119 (81.3%)	1864 (18.7%)
Large town	7495 (28.2%)	5794 (77.3%)	1701 (22.7%)
Total physical activity			
MET min/week (median (Q1;Q3))	1667 (720;3353)	1787 (780;3638)	1160 (477;2300)

those more prone to extensive sedentary behaviour. CHAID has proven useful before in a study on breast cancer, which fed into the development of preventive strategies, (Wewers et al., 2012) as well as in a study that focused on the hierarchy of correlates of walking and obesity (Frank et al., 2008).

The data-driven clusters of factors that were identified here reflect many of the primary clusters of determinants from a systems-based framework of sedentary behaviour that was recently developed (Chastin et al., 2016). The Systems of Sedentary behaviours (SOS) framework was established through an international multidisciplinary consensus process and described sedentary behaviour as the complex interaction of six primary cluster of determinants, most of which showed to play a large role in the hierarchy of factors we found here: physical health and wellbeing, psychology and behaviour, built and natural environment, social and cultural context, institutional settings and politics and economics (Chastin et al., 2016).

The high-sitting subgroups that are also less active may especially be relevant targets for interventions, as recent findings suggest that the ill-effects of sitting too much may be reduced if people are highly active (Ekelund et al., 2016). The tree to which physical activity was added as a predictor variable also showed that type of occupation was, again, the main predictor. Physical activity appeared rather 'high' in the tree consistently showing that those with lower levels of activity had a higher likelihood to be sedentary. The addition of the activity variable also resulted in a slight hierarchical rearrangement of other variables. Interestingly, country of residence now appeared often as discriminator. Because of the addition of physical activity and because country often consisted of many categories, the resulting tree had more branches, but also prevented further dissection of branches as the sample sizes per branch were relatively small.

4.1. Strengths and limitations

Classification trees have certain limitations, the most pressing ones being instability and proneness to overfitting. As stated above, minimum parent-node and child-node sizes were specified to be quite large in order to prevent overfitting. Moreover, as the sample size is large, small data-perturbations will not exert a large effect on the final tree. The final tree must, however, be understood conditional on the included variables: Variable inclusion and/or exclusion will change the tree. Hence, the analysis has an exploratory rather than confirmatory thrust. Other limitations include the cross-sectional nature of the study, which does not allow for causal inference. In addition, the total daily sitting time was self-reported. Self-reported sitting time is known to underestimate actual sitting time, (Healy et al., 2011) so actual sedentary time was presumably higher than presented here. On the other hand, the same was true for the studies included in the meta-analysis which we used for the 7.5 h/day cut point (Chau et al., 2013). Furthermore, whereas the focus of the current study was on socio-demographic profiles, there are other types of correlates of sedentary behaviour - including behavioural correlates - that may act as important discriminators of those who engage in extended sedentary time (O'Donoghue et al., 2016). Lastly, Despite these limitations we were able to use this large sample covering a large geographical area to construct a multi-layered CHAID tree, thus enabling insight as to what socio- demographic factors matter most in relation to sitting too much.

Many interventions to reduce sitting time in adults have been implemented and evaluated over the past few years, so far with small effects, if any (Martin et al., 2015; Lakerveld et al., 2013; Shrestha et al., 2016). The socio-demographic profiles identified here can be used to target and tailor interventions to groups more at risk. Based on the results presented here, the work environment may especially be an important context for interventions to reduce sedentary time - especially for people with desk-jobs and students. In addition, the results indicate that the association of gender with sedentary time may be context-dependent. Moreover, the finding that frequency of internet use is an important correlate opens up opportunities for web-based interventions. Finally, the findings add to a growing body of literature that focus on upstream factors that partially explain health-related behaviours (Lakerveld and Mackenbach, 2017). People in urban environments and people that work in desk-based settings may especially benefit from targeted policies and interventions.

5. Conclusions

Higher socio-economic status subgroups were generally more likely to sit for extended time as compared to people with a lower socio-economic status. Type of occupation was the primary discriminator. In addition, gender, level of urbanisation and internet use were important predictors of sitting >7.5 h/day. Gender differences depended on the specific context.

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Conflicts of interest

None declared.

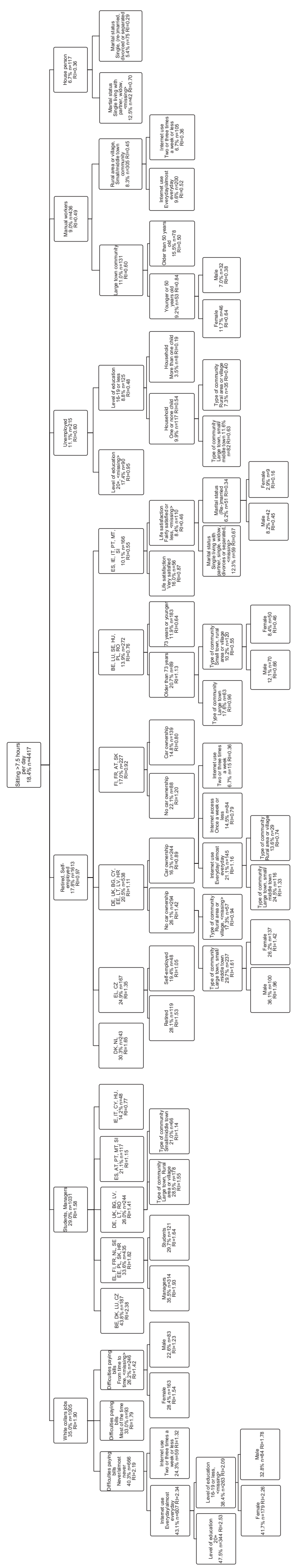

Fig. 1. The Chi Squared Automatic Interaction Detection tree illustrating the hierarchy of socio-demographic correlates in predicting sitting too much RI = Response Index. The RI is the per cent of each subgroup that sit >7.5 h/day, relative to the per cent that sit >7.5 h/day in the total sample (i.e., 18.5%).

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